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# Our Machine Civilization

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*An Address Delivered at the  
Commencement Exercises  
of  
Wellesley College,  
June 20, 1922*



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## OUR MACHINE CIVILIZATION

ONE hundred years ago this summer Harvard College graduated the class of 1822 with sixty members. The Commencement address was given by the Reverend John Kirkland and it was as dreary as Commencement addresses invariably are. It contained all the wise counsel and pious admonition which age habitually gives to youth and which youth habitually disregards. But in the middle of that address, which now lies mouldering in the Harvard library as its author lies mouldering in his grave, the Reverend Mr. Kirkland said a rather startling thing. He referred to the world into which the sixty Harvard seniors were about to step as "a *complex* world." He seemed to infer that the simplicity of older days was gone and that life had become an involved and bewildering process. I am, of course, aware that this has always been to some extent the reaction of old age. Life seems to speed up because age is slowing down. But with all allowance for this natural change in speed, it does seem a bit strange, does it not, particularly from the standpoint of 1922, that the world of 1822 should have seemed to anybody to be *complex*.

For think what the world was like in 1822. In all America, in all Europe; there was not a railroad, nor a telephone, nor a telegraph. The steamboat had just been tried out as a doubtful experiment. Travel was a painful and precarious undertaking, with the result that most people stayed home, living and dying

where they were born. Students at Harvard College living at some distance came by way of the stage coach or on horseback. From South Framingham to Boston was a day's journey when the roads were good, and they were often bad. From Boston to New York was five days. When Samuel Morse, the painter and inventor, tried to get from Washington, D. C. to New Haven, Connecticut, to the bedside of his dying wife, it took him seven days. From one month to three months elapsed before European news reached the United States, and the battle of New Orleans with all its dreadful slaughter was fought in ignorance of the fact that weeks before, peace had been signed between England and America in the city of Ghent in Belgium.

But the world of 1822 had other differences. There were no electric lights, no sewing machines, no bathtubs, no furnaces, no hot water faucets, no asphalt or macadam pavement, no sewer systems—in fact, none of the conveniences which have become an accepted part of the life of 1922. In those days only a small proportion of the population lived in cities. The farm and village housed the rest. The factory system had only just developed—in connection with weaving and spinning—and the home was the unit and center of all the industrial arts. People lived for the most part simply and quietly, engaged in a routine of work from which, in generations, there had been but little variation. Indeed from the days of Rameses II and Moses down to the days of the Reverend Mr. Kirkland and our grandfathers, amazingly few fundamental changes occurred in the material existence of common people. The physical factors of life were practically stereotyped. That long stretch of history is a story of human capacities

undeveloped and natural resources unused. Transportation and communication were no more rapid a hundred years ago when the Reverend Mr. Kirkland was exhorting the sixty Harvard seniors than they were with the ancient Egyptians. Nothing swifter than a horse was known to either Nebuchadnezzar or Napoleon. The farmers around Wellesley in 1822 used the same methods and the same instruments that were used in the days of Julius Caesar.

And remember this was only a hundred years ago. I am not talking about ancient history; I am talking of conditions of life in the days of our grandfathers.

But there were other differences between those days and these. When Mr. Kirkland made his Commencement address, Charles Darwin was only thirteen years old and the whole foundation of modern biology and modern philosophy as well was yet to be laid. Agassiz was fifteen years old; Sir Charles Lyell was twenty-five years old, and the crude geological conceptions of Linnaeus and Lamarck were still in vogue. In the general field of chemistry and physics Michael Faraday was just beginning his work. In the field of medicine, Jenner was still alive, and his idea of vaccination against small-pox was just beginning to win its way. Lord Lister and Louis Pasteur were not yet born, and anesthetics and antiseptic surgery were unknown to the world. In the realm of astronomy, Pierre Laplace, who originated the nebular hypothesis, was still alive, while J. C. Adams, his successor in the field of mathematical astronomy, was only three years old. Many of the subjects which you young women have studied in your four years at Wellesley were unheard of. There was no such thing as experimental psychology,



for example, and the word sociology did not exist in the English language. The average college curriculum of 1822 consisted principally of Latin, Greek and mathematics, sweetened with a dash of what was called "natural philosophy," and accompanied by liberal doses of the theology of Jonathan Edwards.

This, then, is what the world was like in 1822 when the Reverend John Kirkland called it *complex*. It was a world just waking from a long sleep. It was a world that was rubbing its eyes in the presence of new forces. If that world seemed complex to the sixty Harvard seniors of the Class of 1822, what does the present world seem to us!

For between that time and this, between the days of our grandfathers and ourselves, has occurred the mightiest revolution in history. It has completely changed the whole complexion of human life. It has fundamentally altered our daily habits; it has not only modified our environment, but has thoroughly revolutionized it; it has split the anciently established order into a thousand fragments. Since the days of Assyria and Babylon—indeed since the days of our Neolithic forefathers—nothing has occurred which has so completely and in so short a time changed the method and manner of living of the human race, as the mechanical revolution of the nineteenth century.

For think what has happened. With the advent of steam and electricity we have annihilated the difficulties of space and distance. When Napoleon was retreating in headlong fashion from Moscow, it took him 312 hours to complete the last leg of his journey from Vilna to Paris. Any traveller can now do it in less than 48 hours by railroad or in 8 hours by



airplane. We cross the ocean in five days, where a century ago it took two months. We fly by airplane from one city to another, from one country to another, in a few hours' time. Our fast mails go by airplane. In our automobiles we pass from state to state and see in a day more than our grandfathers could have covered in a month. By cable and wireless we are in immediate and constant touch with the uttermost parts of the earth. With our own voices we talk to our friends a thousand miles away. Seated in our own libraries we hear concerts and lectures that are hurled to us through the air from 500 miles or more away. We hear Galli-Curci and Sembrich in our own homes, and Caruso returns from the dead to sing to us. Events that few could witness are brought to the whole human race on the celluloid film: we see the King of England walk through Westminster Abbey to lay a wreath on the tomb of the unknown soldier, and we see and hear the President of the United States speaking in Arlington Cemetery. If the Reverend Mr. Kirkland, who winced at the complexity of 1822, could return to us today, what would he think of our generation!

But the scientific revolution has done a thousand other things. It has given us not only new commodities but new substances. We juggle with the atoms of carbon and hydrogen and the rest, and create materials that Nature herself has not formed. We make carborundum and acetylene gas and celluloid and hundreds of other compounds which we use in our daily lives. What we formerly obtained from plants and animals we now manufacture. We make dyes and medicines from coal tar; we extract sugar from beets; we make perfume out of garbage, and foodstuffs out of sewage. From corn we take a hun-

dred useful products ranging all the way from salad oil for our tables to the erasers on our pencils. Luxuries that were formerly the monopoly of the privileged few are now the common property of everybody. Medicines such as a prince could not have had a century ago are now at hand to cure the pauper. Vegetables and fruits, exotic and out of season, are upon our dinner table. Our daily food is brought from China, from the West Indies, and from the far islands of the Pacific. The royal purple of the ancients, and dyes far more beautiful than they knew, are now to be had on the bargain counter.

But the scientific revolution has not only added to our conveniences; it has altered our methods of living. Our populations are no longer predominantly rural. They live in huge cities, crowded together in communities such as the world never knew before. The day of individual work, for one's own needs, in one's own way and in one's own time, has gone. Instead, men work in vast factories, engaged on minute contributions to the finished article. Hundreds of thousands of men work underground, digging the coal to feed the monster industrial machine. Millions of men, women and children toil feverishly to keep it going, and the whole system is so inconceivably intricate and so closely articulated that dislocation in one part of it affects all the rest, and industrial cohesiveness has come to be a more essential factor in the world than political cohesiveness. For example, you cannot have clothes without a cotton mill; you cannot have a cotton mill without machinery; you cannot have machinery without steel; you cannot have steel without iron; you cannot smelt iron without coal; you cannot have coal

without railroads to bring it to you; you cannot have railroads without involving a hundred occupations and enterprises. Civilization has in fact become a great machine, the wheels of which must be kept turning, or the people starve. For millions of human beings it is a vast treadmill, worked by weary feet to grind the corn that makes the bread that gives them strength to walk the treadmill.

And with it all has come the speeding up of life, and the spirit of hurry and worry such as our grandfathers with all their lack of conveniences never dreamed of even in their nightmares. The human race lives by schedule, according to a stereotyped routine. Life has become more and more a standardized process, in which there is little of serenity or of leisure. We hurry from birth to death, goaded only to greater haste by our increasingly speedy conveyances, feverishly trying to catch up with the machinery which we have ourselves created. Truly this is a *complex* world. The sixty Harvard seniors of the Class of 1822 would stand aghast at our hectic civilization.

And with the increase of machinery has come the increase of human knowledge. Rather it is the increase of knowledge that has made all these inventions possible. For the scientific revolution of the nineteenth century was born of a great intellectual curiosity and a new method of approach. When Francis Bacon first emphasized the importance of the experimental method as an approach to human knowledge, he was sowing the seed which began to develop to its full fruition in the nineteenth century. The old accepted facts of nature were tested and analyzed. Nature herself was put in the witness box and experiment was the interrogating counsel. All

the phenomena of life, whether pertaining to the body, the brain, or the soul, were haled for examination before the court. Under the stimulus of this method, we have pushed back the boundaries of human knowledge far, far beyond where they were a century ago. In biology, in surgery, in medicine, in physics, chemistry, astronomy, and in a score of other sciences, we have wrenched the facts from nature by a process of cross-examination which would not be denied. As the inquiries have grown in detail and complexity, dozens of new sciences have been added to the list. The body of knowledge has developed bewilderingly. The long-hidden secrets of life are slowly becoming ours. We have traced man back to the Tertiary Period and we are reaching long fingers of inquiry into the universe of which we form so minute a part, and beyond this universe into other universes, where life and intelligence may exist, far transcending our tiny comprehension. We are almost intoxicated with the new knowledge. We stand on tiptoe before each new promise of discovery, feverishly awaiting its outcome. The telescope, the microscope, the spectroscope, are daily bringing us information that leaves us gasping; and we are stunned by the realization that in this thirsty search for knowledge we are just at the beginning of the way. Ahead of us lies a long, rising road, with ever-broadening outlooks on either side.

This is the kind of complex world into which your class is stepping. A hundred years ago it is conceivable that a man might acquire and digest a fairly substantial proportion of the body of human knowledge. At least he could easily find a point of orientation from which he could intelligently survey the

course, and keep up with the progress of the march. Today this is utterly impossible. In the growing complexity of knowledge one can scarcely find his way. Whole groups of conclusions must be accepted without analysis or examination, and most of the departments of learning we cannot even enter. In your four years at Wellesley you young women have scarcely touched the garment's hem of human knowledge. If you have obtained the scantiest outline, or a point of view, or a method of approach, you have gotten all that any college can hope to give to its graduates.

I wonder if you have seen in this long analysis that I have made where my thought is leading. Comparatively speaking, what a simple task those sixty Harvard seniors faced when they stepped out into the world a hundred years ago and upon what simple responsibilities they entered! The environment of their lives was so easily understood and controlled. The problems of daily existence were so reasonably adapted to their capacities. You young women, on the other hand, are projected into a world so complex, into an environment so baffling, that few individuals can understand it all, and fewer still can control it. You have been educated for leadership at a time when leadership is increasingly vital in the service of men and increasingly difficult to establish. You will be tested with cruel burdens in a way your grandfathers *never* were tested. You must carry responsibilities that would have broken the backs of your forebears a century ago. This is the price that you pay for your privileges here at Wellesley; this is the penalty of education in this generation. The thing that you win today is not a reward, but a re-



sponsibility; not an easy entrance to a quiet and agreeable life, but a crushing obligation to lead your generation in such fashion that it may indeed become the master of its environment.

I wish I could paint the nature of that obligation as I see it this morning without seeming to use merely resounding and empty words. Perhaps I can illustrate what I mean by an example from the field of government, although this is just one department of life in which difficulties are multiplying. Government a hundred years ago was a comparatively simple affair. It dealt with matters that were easily within the scope of intelligence of the average man. In its practical aspects there was little that was technical about it. Locally it had to do with good roads and water supply and common lands and other matters, which could readily be considered in town meeting and upon which the least intelligent could have an opinion that might be valuable. Even in its national aspect government was not complex. There were few technical bureaus and those that existed did not affect the daily lives of the citizens. There was no problem of transportation, because there were no railroads; there was no perilous conflict between capital and labor, because there were no machines, no mass production, and no specialization of industry. The scope of government in those days was largely negative. It was built around the principle of *thou shalt not*, and was based on simple moralities which appealed to the understanding and reason of the average man.

But those days are gone. The scientific revolution has wiped them out as completely as if they had never existed. Government has become infinitely complex and technical. It has to do for the most

part with matters which are far beyond the intelligence of the average citizen. It deals with complicated bond issues, with subtle transportation problems, with involved plans of taxation and tariff, with technical educational projects, and with a hundred other matters, which directly affect our lives and happiness, and in regard to which we are called upon to express our opinion as citizens. Consequently, the breach between the citizenship and its government is widening as science increases the complexity of its operations. Our elections, many of them, are fought out on the basis of issues about which we voters have no intelligent conception whatsoever, nor could a majority of us acquire such a conception even if there were time and machinery for our education. Frankly the situation has gotten beyond us. Even in my time in New York City I have seen the function of government increase in elaborateness and complexity until now there are few people who really understand all its technical complications. Government is getting out of the hands of the people, not in the sense that anybody is taking it away from them, but in the sense that with the rapid extension of its technical aspects, it is becoming more and more difficult to comprehend and control.

It is right at this point that we often make a fundamentally erroneous assumption. We assume that man's capacity keeps up with his inventions. We assume that as civilization becomes great, the human stock which is building it also becomes great; that somehow or other, by some alchemy or other, there is a rise in individual capacity from generation to generation to match the increasing complexity of our physical environment. We seem to take it for



granted that there is some sure inhibition that would prevent men from creating machines which they could not control; and that the very fact that they have created them is proof of their ability to manage them.

But this is not the fact. Knowledge may mean power, but it does not necessarily mean capacity. We cannot be dogmatically sure that there has been substantial improvement in the human stock since the days of the Egyptians or the Greeks. The men who labored with their hands to build Cheops' pyramid probably had wit enough and intelligence enough to use a steam hoist and a concrete-mixer if these inventions had been given to them. Even less sure can we be that this last century which has added so tremendously to our mechanical environment has brought a corresponding improvement in human capacity. In fact we know that it is not true. Men were no less able in the days of Washington and Hamilton, and Channing and Fox than they are to-day. We have come into our new inheritance with no greater abilities than our grandfathers had. The difference between the Harvard Class of 1822 and the Wellesley Class of 1922 lies not in their respective capacities, but in the loads which those capacities must bear.

In this field of government, therefore, our task is to control complex functions like subways and street railroad financing with the same intelligence that was adapted to the spade and the blacksmith shop. The machinery of our environment is increasing in complexity, but the tools of control remain largely the same.

And how faulty those tools may be we are only just now beginning to realize. We have always

thought of the American people—our own people—as being peculiarly intelligent. We have had a conscious pride in the ability of the average man and in our great experiment of democracy, based on the principle of equality of responsibility. And now come the statistics of the government gathered from our army during the war, when for the first time we had the opportunity of testing by modern scientific methods the intelligence of a substantial cross-section of our people. Of the white draft—that is, the white soldiers as opposed to negroes—thirty per cent were found to be unable to read and understand newspapers or to write letters home. Forty-seven and three-tenths per cent of the white draft fell below the mental age of thirteen years, only one year over the maximum mental age of what are generally known as morons. Forty-seven and three-tenths per cent! Sixty-six and two-thirds per cent of the white draft tested below a percentage that marked the minimum capacity necessary to carry on the so-called paper work of the army—that is, making reports and keeping the files. Out of all those millions of drafted men just a third had ability enough to carry on this by no means laborious type of mental work.

The appalling significance of these statistics it is impossible to escape. They cannot be explained away. We had the best blood of America in the army. Those men represented certainly our average intelligence and capacity. They reflected our citizenship with substantial accuracy. And yet thirty per cent of them were unable to read and write, and nearly fifty per cent fell below a mental age of thirteen years! These are the people upon whom our complex life is placing its gigantic responsibilities.

These are the human tools through which we fondly hope that all this unintelligible machinery of civilization may somehow or other be intelligently controlled.

I say therefore that you young women are facing the supreme challenge of human history, and I repeat that your diploma today is not a reward but a crushing obligation. The future looms like an angry cloud, and whatever of leadership and spiritual force you have gained here at Wellesley is needed now more than at any other moment in the progress of the race.

For it cannot be denied that humanity stands today in a position of peril. One great, unanswered question is written across the future in letters of fire: Is man to be the master of the civilization he has created, or is he to be its victim? Can he control the forces which he has himself let loose? Will this intricate machinery which he has built up and this vast body of knowledge which he has appropriated be the servant of the race, or will it be a Frankenstein monster that will slay its own maker? In brief, has man the capacity to keep up with his own machines?

This is the supreme question before us. All other problems that confront us are merely its corollaries. And the necessity of a right answer is perhaps more immediate than we realize. For science is not standing still. In speaking of the scientific revolution I was not speaking of a phenomenon that was confined to the nineteenth century. Rather we are just at the beginning of the revolution. We could not stop it if we would. It is advancing by leaps and bounds, gaining in impetus with each year. It is giving us more machines, faster machines, machines increasingly more intricate and complex. Life in the future will

be speeded up infinitely beyond the present. Sources of energy will be tapped and harnessed far out-rivalling what we have today. There lies in full view before us a realm of discovery in physical science till now untrodden by mortals even in their dreams. The pioneers are already upon the road to this promised land. In California at the present moment a combined attack, financed and equipped on a huge scale, is being launched on the problem of the structure of matter; and the same search is being feverishly prosecuted in laboratories all over the world. We now know that in atoms of matter there exists a store of energy incomparably more abundant and powerful than any over which we have thus far obtained control. If once we can liberate this force, what machines we can build! Steam and electricity will be an anachronism at which our children will laugh as we laugh at the hand-loom and the spinning wheel. With a pound weight of this radioactive substance we will get as much energy as we now obtain from 150 tons of coal. Or another pound weight can be made to do the work of 150 tons of dynamite.

Aye, there's the rub. One hundred and fifty tons of dynamite—enough to blow the city of Boston into oblivion—compressed to a pound weight which might be held in the hand! Do you wonder that a sober-thinking scientist like Professor Frederick Soddy of Oxford University should say "I trust this discovery will not be made until it is clearly understood what is involved." "And yet," he goes on to say, "it is a discovery that is sooner or later bound to come. Conceivably it might be made tomorrow."

You see what the problem is. Science will not wait for man to catch up. It does not hold itself responsible for the morals or capacities of its human

employers. It gives us a fire engine with which to throw water to extinguish a fire; if we want to use the engine to throw kerosene on the fire, that is our lookout. The engine is adapted to both purposes. With the same hand, science give us X-rays and machine guns, modern surgery and high explosives, anesthetics and poison gas. In brief, science has multiplied man's physical powers ten thousand fold and in like ratio has increased his capacity both for construction and destruction. How is that capacity to be used in the future? How can we hold in check the increasing physical power of disruptive influences? Have we spiritual assets enough to counter-balance the new forces? How can we breed a greater average intelligence? Can education run fast enough, not only to overcome the lead which science has obtained, but to keep abreast in the race?

These are ugly questions and they carry with them a perilous significance. They are hurled as a challenge to your generation, and upon their answer depends the whole future of the race. And what are the answers? Let us be perfectly frank about the matter: No intelligent person in my generation—if for a moment I may associate myself with the elder statesmen—pretends to know. We are wandering in heart-breaking perplexity, swamped with the paraphernalia of living, weighed down by mountains of facts, trying to find some sure way out of this jungle of machinery and untamed powers. And the tragedy of it all is that there was a time when we thought we knew the answers to the riddles that this modern life of ours was propounding. Up until 1914 most of us were fairly confident of the result, fairly easy about the future. We talked glibly of the direction



and goal of human evolution, and of the bright prospects of the race. But now we know that we did not know. We were misled by superficial hopes, blinded by false assumptions. Those four years of slaughter, and those added four years of chaos and misery that have followed since the Armistice, have given us a perspective we did not have before. We see now the abyss upon the edge of which the race is standing. We see the inevitable doom that lies ahead unless we can achieve a measure of social control far greater than any which we have hitherto exercised. Bewildered and disillusioned, my generation turns to yours—and upon your shoulders falls the weary weight of all this unintelligible world. Out of all times and peoples, a capricious fate seems to have singled your day and your generation upon which to center its heaviest responsibilities.

I do not know how you are going to attack this problem of strengthening the social controls. I have no specific advice to offer. With the tragic failures of my own generation in mind, I would have some reluctance about lecturing you on the principles of success, even if I knew what they were. My generation has been far more modest since 1914, far less confident and dogmatic. I presume, however, that in your program, education will play an increasingly important part, although what kind of education is best adapted to this crisis, and how it is to be applied, my generation cannot tell you. Surely let us hope that in your time no such damning charge will be leveled against you as has been brought against us: that thirty per cent of the people of free America are unable to read and write, and that nearly half our population has a mental age of less than thirteen years.

And after education, what? Frankly I do not know. In the confused councils of my generation many things are being advocated. There are those who claim that the environmental attack upon which my generation has put such emphasis cannot possibly succeed and that the only hope of the future lies in improving the quality of the human stock by the introduction of better strains. Consequently the science of eugenics is attracting ever wider attention. There are others who claim that the hope of the world does not lie in democracy—because the complications of civilization make mass-verdict of value only in the simpler issues—but lies rather in an aristocracy of leadership, recruited from all classes of society on the basis of merit. There are still others who look for social control only in a fundamental reorganization of human society, with the purpose of revising the attitude of men toward wealth production and distribution. Still others are looking for a solution in social cooperation—if only it can be brought about—not only as between individuals within a class, but as between classes within a nation and nations within a league. Again, there are many of us who fervently believe that the spirit of Christianity contains the key to the solution of this great crisis, if only that spirit can be practically applied. How this is to be done in comprehensive fashion, however, my generation cannot tell you, and we hang our heads in shame at our own failure.

You see with what confusion the discussion is being carried on in the councils of my generation. There is no unanimity of opinion; indeed, very little coherence of opinion. Like those who built the Tower of Babel in the land of Shinar, we are smitten with many tongues and many counsels.



But one thing we know: the way out of this morass, if it is found, will be found by a leadership of intelligence. It will be discovered by knowledge consciously applied to the task. For that leadership and that knowledge we cannot look to the many. We must look to the few. We must look largely to that handful of men and women who each year come from our universities. That is why your graduation today is so significant an event. It contains a promise for the future; it holds out a hope of healthier days. There is here in your group the possibility of vision and creative leadership such as the world needs now more than at any time in its history.

So I welcome you to the grim struggle that awaits you. You are joining the ranks of a gallant army—the army of the Kingdom of the Spirit. It has fought in many ages on many a field and has many times been vanquished. Just now it is desperately hard-pressed. Its ranks are torn and its flags are going down. It is being attacked by an enemy far more powerful and determined than any with which it has previously fought. It badly needs the reinforcement which you are bringing. If you can come with more intelligence, more resourcefulness, and more devotion than previous generations have shown, the day may be saved. But if your generation fails, as the generation for which I speak failed in all the years that led up to 1914, then there is little hope, “and we are here as on a darkling plain,

Swept with confused alarms of struggle  
and flight,

Where ignorant armies clash by night.”

God give you high courage in the army of the Kingdom of the Spirit!





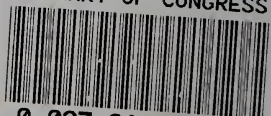
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